A bird in the hand . . .

HARDWARE AND INTELLIGENCE ANALYSIS

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INTRODUCTION

The process of assessing the capabilities of modern foreign weapons systems historically has been one of deduction: analysts use an incomplete set of discrete kinds of information to form the basis for a rational judgment concerning the range, payload, speed, and additional vital characteristics of a missile, aircraft, submarine, or other implement of destruction.

Most of the available facts which contribute to this process do so only indirectly. Take, for instance, the application of telemetry data. These data must first be processed to identify the quantities being monitored, and then calibrated before they can be used in weapons analysis. This in itself is an estimative process requiring certain assumptions. The connection between the resultant data and the weapon performance requires further assumptions.

Other important contributors to weapons analysis include photography, radar tracking, COMINT, and ELINT. None of these can be relied upon directly to provide systems performance information. But each can provide some insights which, taken together, lead to performance estimates.

There is a way, however, to obtain direct information on a weapon, and that is to get one. How high and fast can a new aircraft fly?—encourage delivery by a defector. What is the performance of an antiaircraft missile?—buy one through a third party. How well are submarines constructed?—grapple one up from the depths of the ocean. Easier said then done, of course, but there have been some impressive hardware successes over the years. And many have yielded important intelligence information, sometimes at relatively modest cost, and sometimes at great cost and risk. Hardware, available only relatively late in a weapon program, cannot match the timeliness of COMINT, telemetry, and other data. But hardware does provide a base for comparing the results of deductive analysis, and at times also provides certain unique insights.

One of the most spectacular examples of hardware collection is the Glomar Explorer adventure—Project AZORIAN. This program has been described in detail in *Studies* (Volume 24, Number 5) and addressed at some length in numerous newspaper articles during the 1974-1975 period. The cost was high and the risk was substantial, but the potential payoff was deemed worth both the cost and the risk. There have been, however, many less glamorous and less publicized projects which have contributed markedly to our understanding of foreign weapons. A few of these are described herewith, by the people who have been closely associated with them.

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Both men and ships
live in an unstable environment,
are subject to subtle and diverse pressures
and want to have their merits
understood rather than their
faults found out.

Joseph Conrad
The Mirror of the Sea

Webster's New Collegiate Dictionary defines intelligence as "the ability to learn or understand or to deal with new or trying situations." Intelligence is also defined as "information concerning an enemy or possible enemy or an area." We who deal in intelligence in its second sense are charged with providing "intelligence consumers" with information necessary for intelligent decision making. We have important intelligence consumers who deal in technical esoterica. This type of intelligence often has strong impact on technical decision making. Its effect can ripple upward through scientific and engineering channels to influence national policy.

Our technical customers sometimes view the information we provide with skepticism, especially if it presents "new or trying situations." Much has been said, though less has been written, about "N.I.H.", the "not invented here" attitude which takes as a given the technical superiority of the United States in all areas. This is not an all pervasive attitude; but it is much easier to convince the skeptic of the truth of intelligence analysis showing significant foreign technical achievements if there is hardware in hand, hardware which can be examined, tested, and evaluated in the cold light of science.

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In this case there has been an additional plus. There is an engineering truism that you are half-way to a solution when you know that, in fact, there is one. And you are three-quarters there when you know how a competitor solved the problem. [redacted] (b)(1) fabrications is providing the U.S. research and development community with [redacted] (b)(1)

These two examples in this specialized field, in which I served as a technical analyst for over six years, highlight to me some fundamentals of intelligence analysis:

- One can build an air-tight case on the basis of indirect and collateral information. Yet there will be those who doubt the results.
- Skeptics cannot argue with material evidence. To end all doubts one must "hit them with the submarine."
- Information is our most important product. This includes the technology arena as well as that of the policy maker.

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SOVIET SOLID STATE ELECTRONICS

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One of my former professors, a dedicated theoretician, regularly cautioned young theoretical aspirants that, no matter how brilliant their theory, it would never stand alone like the results of a well planned and properly executed laboratory experiment. Correspondingly, the "hands-on" examination of Soviet solid state electronic components—particularly the more advanced components such as microcircuits—dispels questions as to whether such Soviet devices exist, and permits the determination of fabrication techniques, performance, and quality of the devices more effectively than trying to learn about them from published data or reports from scientific and technical conferences.

With regard to dispelling disbelief, a significant portion of the intelligence information that Department of Defense personnel alluded to in their early writings stressing the need for a very-high-speed-integrated-circuit (VHSIC) development program was the "hands-on" examination of Soviet microcircuits. These were of a greater complexity than we previously believed existed.

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* Hybrid—a microcircuit where discretes such as transistors and diodes are mounted on a ceramic substrate, mechanically interconnected and then packaged.

** Monolithic microcircuits or integrated circuits (ICs) are devices where discretes and their interconnects are etched by photolithographic techniques on a single crystal silicon chip and then packaged.

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HARDWARE FROM SPACE

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Technical intelligence analysis is generally based on esoteric, as well as mundane, data types. The analysis of Soviet spacecraft includes tracking and telemetry data, photography, optics, (b)(1) electronic, and communications intelligence. The questions asked are: what does the satellite do, and

how well does it do it? Unlike analysis of, say, missile systems, where the missile's function usually is known, spacecraft analysis is highly dependent on data interpretation, analytical skills, luck, and "warm feelings". Skeptics believe the crystal ball is our main analytical tool.

It is not very often in intelligence analysis, and especially in the analysis of Soviet spacecraft, that we are able to prove not only our analytical findings, but also to test our analytical techniques.

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SOVIET INTERCEPTOR AIRCRAFT

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The Western world's understanding usually lags by many years the development of typical new Soviet weapons. During tbe conceptualizing and early R&D periods, there is little available in the way of data upon which to base intelligence judgments. But as the years go by, and prototype testing is conducted, followed by full system tests, deployment, troop training activity, and operational status, we gain access to a growing body of data to analyze. Normally our estimates of weapon capabilities also grow better, eventually reaching a plateau, an upper limit. How well we ultimately understand system performance—that is, how far from "ground truth" we are—depends both on our analytical skills and on the data available. Hardware exploitation can substantially raise our level of understanding. But hardware is not usually available until routine testing has begun, so that the benefits come in the mid- to late-life of a weapon. Denial of conventional data, on the other hand, can seriously degrade our understanding, particularly in the early years of a weapon cycle. Hardware exploitation can, in many instances, alleviate the adverse effects of data denial. Timeliness is, of course, as important for intelligence estimates as accuracy. In the case of weapons threat assessment, a major customer is the US weapons development community. The kinds, capabilities, and numbers of new US weapons depend in part on the direction of the Soviet weapons programs. The sooner US designers bave this information, the more effective and realistic will be their efforts. We consequently cannot expect the loss of conventional data sources to be fully replaced by

hardware collection and exploitation, because the former become available much earlier in the development cycle than do the latter. Hardware serves to improve the accuracy of our estimates, rather than the timeliness. Thus, foreign hardware can be used to influence the details of US weapons—for example, armor, electronic countermeasures, warhead size—but not the weapon concept.

While the direct military threat from the Soviet Union is the most important target of the Intelligence Community, other results of intelligence analysis are also important and significant. One of these—technology transfer—is uniquely enhanced by hardware exploitation. Technology transfer can, of course, work both ways. The Soviets acquire and use US technology, but we also can gain from understanding Soviet technology and practices. The acquisition and exploitation of Soviet cruise missile hardware in the late 1960's and early 1970's provided examples of tecbnology transfer in both directions.

Double Reverse Technology

In the late 1950's, laboratories at the Massachusetts Institute of Technology were engaged in research and development of a military application servomechanism to deliver a high force quickly and accurately. The device which evolved from this research was a hydraulically powered actuator with a novel control concept called "force compensation". This concept was a means to overcome the inertia associated with high force devices which must respond quickly to autopilot demand. The researchers at MIT were successful with their design, but could not perfect it for mass production because of the critical requirement for fabrication under extremely close manufacturing tolerances necessary to prevent high frequency vibrations (chatter) during operation. The associated bigh cost of manufacturing was not considered practical, and the project was brought to a close. The design results of the MIT project were published in an unclassified research report.

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